

CLAIMS:

1. Control mechanism for an endoscope having a flexible shaft, comprising:
 - a frame;
 - first and second movement transmission devices for causing adjustment of a distal end of the flexible shaft;
 - a first control knob;
 - a first rotatable pinion shaft rotatably mounted on said frame and fixed to said first control knob, said first pinion shaft engaging with said first movement transmission device such that upon rotation of said first control knob, said first pinion shaft rotates and said first movement transmission device is actuated;
 - a second control knob rotatable independent of said first control knob;
 - a second rotatable pinion shaft fixed to said second control knob and coaxial with said first pinion shaft, said second pinion shaft engaging with said second movement transmission device such that upon rotation of said second control knob, said second pinion shaft rotates and said second movement transmission device is actuated; and
 - an intermediate shaft arranged at least partially inside of said second pinion shaft and at least partially around said first pinion shaft, said intermediate shaft being arranged to reduce transmission of torque between said first and second pinion shafts such that rotation of one of said first and second pinion shafts does not cause rotation of the other of said first and second pinion shafts,
 - said intermediate shaft being axially unrestrained such that movement of said intermediate shaft in an axial direction is possible.
2. The control mechanism of claim 1, further comprising at least one O-ring arranged on said first pinion shaft and in contact with said intermediate shaft such that torque transmitted by said first pinion shaft to said at least one O-ring is applied to said intermediate shaft.
3. The control mechanism of claim 2, wherein said first pinion shaft includes at least one circumferential groove for receiving a respective one of said at least one O-ring.
4. The control mechanism of claim 2, wherein said at least one O-ring is arranged to provide a rotary seal between said first pinion shaft and said intermediate shaft.
5. The control mechanism of claim 1, further comprising at least one O-ring arranged on said intermediate shaft and in contact with said second pinion shaft such that torque

transmitted by said second pinion shaft to said at least one O-ring is applied to said intermediate shaft.

6. The control mechanism of claim 5, wherein said intermediate shaft includes at least one circumferential groove for receiving a respective one of said at least one O-ring.

7. The control mechanism of claim 5, wherein said at least one O-ring is arranged to provide a rotary seal between said second pinion shaft and said intermediate shaft.

8. The control mechanism of claim 1, further comprising a first O-ring arranged on said first pinion shaft and in contact with said intermediate shaft such that torque transmitted by said first pinion shaft to said at least one O-ring is applied to said intermediate shaft and a second O-ring arranged on said intermediate shaft and in contact with said second pinion shaft such that torque transmitted by said second pinion shaft to said at least one O-ring is applied to said intermediate shaft.

9. The control mechanism of claim 1, further comprising fixing means for fixing said intermediate shaft against rotation.

10. The control mechanism of claim 9, wherein said fixing means comprise a pin attached to said frame and extending into a slot formed in said intermediate shaft.

11. The control mechanism of claim 1, further comprising ball bearings arranged between said second pinion shaft and said intermediate shaft for enabling rotation of said second pinion shaft relative to said intermediate shaft and between said intermediate shaft and said first pinion shaft for enabling rotation of said first pinion shaft relative to said intermediate shaft.

12. The control mechanism of claim 1, further comprising a nut fixed to said frame, ball bearings arranged between said second pinion shaft and said frame for rotatably mounting said second pinion shaft to said frame and at least one hard spacer arranged between said nut and said ball bearings to allow floating of said intermediate shaft.

13. The control mechanism of claim 1, further comprising a nut fixed to said frame, ball bearings arranged between said second pinion shaft and said frame for rotatably mounting said second pinion shaft to said frame and a preload spring arranged between said nut and said ball bearings, said ball bearings being preloaded.

14. Control and sealing mechanism for an endoscope having a flexible shaft, comprising:

a frame;

first and second movement transmission devices for causing adjustment of a distal end of the flexible shaft;

a first control knob;

a first rotatable pinion shaft rotatably mounted on said frame and fixed to said first control knob, said first pinion shaft engaging with said first movement transmission device such that upon rotation of said first control knob, said first pinion shaft rotates and said first movement transmission device is actuated;

a second control knob rotatable independent of said first control knob;

a second rotatable pinion shaft fixed to said second control knob and coaxial with said first pinion shaft, said second pinion shaft engaging with said second movement transmission device such that upon rotation of said second control knob, said second pinion shaft rotates and said second movement transmission device is actuated;

an intermediate shaft arranged at least partially inside of said second pinion shaft and at least partially around said first pinion shaft; and

at least one O-ring arranged in contact with said intermediate shaft and one of said first and second pinion shafts such that torque transmitted by said first or second pinion shaft to said at least one O-ring is applied to said intermediate shaft and transmission of torque between said first and second pinion shafts is reduced, said at least one O-ring being arranged to provide a rotary seal between said intermediate shaft and said one of said first and second pinion shafts.

15. The mechanism of claim 14, wherein said at least one O-ring is arranged on said intermediate shaft and in contact with said second pinion shaft such that torque transmitted by said second pinion shaft to said at least one O-ring is applied to said intermediate shaft.

16. The mechanism of claim 15, wherein said intermediate shaft includes at least one circumferential groove for receiving a respective one of said at least one O-ring.

17. The mechanism of claim 14, wherein said at least one O-ring is arranged on and in contact with said first pinion shaft such that torque transmitted by said first pinion shaft to said at least one O-ring is applied to said intermediate shaft.

18. The mechanism of claim 17, wherein said first pinion shaft includes at least one circumferential groove for receiving a respective one of said at least one O-ring.

19. The mechanism of claim 14, wherein said at least one O-ring comprises a first O-ring arranged on said intermediate shaft and in contact with said second pinion shaft such that torque transmitted by said second pinion shaft to said at least one O-ring is applied to said intermediate shaft, and a second O-ring arranged on and in contact with said first pinion shaft such that torque transmitted by said first pinion shaft to said at least one O-ring is applied to said intermediate shaft.

20. The mechanism of claim 14, further comprising a nut fixed to said frame, ball bearings arranged between said second pinion shaft and said frame for rotatably mounting said second pinion shaft to said frame and at least one hard spacer arranged between said nut and said ball bearings to allow floating of said intermediate shaft.

21. The mechanism of claim 14, further comprising a nut fixed to said frame, ball bearings arranged between said second pinion shaft and said frame for rotatably mounting said second pinion shaft to said frame and a preload spring arranged between said nut and said ball bearings, said ball bearings being preloaded.